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Empowering Woman in Building Information Modelling (BIM): Overcoming Barriers in Advancing Inclusivity in Russia and Serbia

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ABSTRACT

This paper investigates the systematic obstacles restricting women's involvement and leadership in Building Information Modelling (BIM) related occupations in Russia and Serbia. Using a qualitative literature-based approach, the study draws on gender role theory, digital divide theory, and structural inequality theories to combine data from peer-reviewed academic and policy sources. Findings show widespread wage disparities, occupational segregation, underrepresentation in digital leadership, and inadequate mentoring systems. While Serbia shows more informal business routes with less structural assistance, Russia's workforce shows more centralized obstacles with policy immobility. Although BIM, which is part of Construction 4.0, has possibilities for inclusive change, its use in both nations runs the danger of repeating gender inequalities without coordinated institutional change. Strategic advice comprises national policy integration, focused leadership initiatives, inclusive upskilling, and entrepreneurial support structures. Focusing on under-researched post-socialist settings, this work provides to the changing worldwide conversation on gender inclusiveness in STEM.

Keywords: women in BIM, STEM, Gender Diversity, AEC Industry, Digital Transformation, Building Information Modelling, Leadership.

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Расширение прав и возможностей женщин в области информационного моделирования зданий (BIM): преодоление барьеров на пути развития инклюзивности в России и Сербии

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РЕФЕРАТ

Данная статья исследует системные препятствия, ограничивающие участие женщин и их лидерство в профессиях, связанных с информационным моделированием зданий (ВІМ — Building Information Modelling) в России и Сербии. С помощью качественного подхода, основанного на литературных источниках, исследование опирается на теории гендерных ролей, цифрового разрыва и структурного неравенства, чтобы объединить данные из рецензируемых академических и политических источников. Результаты показывают широкое расслоение по оплате труда, профессиональную сегрегацию, недопредставленность женщин в цифровом руководстве и недостаточную систему наставничества. В то время как Сербия демонстрирует более неформальные бизнес-стратегии с меньшей структурной поддержкой, в России наблюдаются более централизованные препятствия с политической инертностью. Несмотря на то, что ВІМ, являясь частью Строительства 4.0, имеет потенциал для инклюзивных изменений, его использование в обеих странах может привести к повторению гендерных неравенств без координированных институциональных изменений. Стратегические рекомендации включают интеграцию национальной политики, фокусированные инициативы по лидерству, инклюзивное повышение квалификации и поддерживающие предпринимательские структуры. Сосредоточив внимание на недостаточно исследованных постсоциалистических контекстах, данная работа способствует изменению глобальной дискуссии о гендерной инклюзивности в STEM.

Ключевые слова: женщины в ВІМ, STEM, гендерное разнообразие, АПК-отрасль, цифровая трансформация, информационное моделирование зданий, лидерство.

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Introduction

National economies depend much on the Architecture, Engineering, and Construction (AEC) sector, which shapes jobs, infrastructure development, and technical progress. With Building Information Modelling (BIM) as its foundation, the sector has started a digitization transition during the last twenty years. From design through construction to facility maintenance, BIM is a complete digital ecosystem enabling cooperation, coordination, and data integration over the project lifetime, not just a 3D modeling tool [8; 11]. Many nations have included BIM standards in their larger digital transformation initiatives.

Notwithstanding these developments, notable gender differences remain. Though digitalisation promises to change conventional labor structures, women still make an underrepresented group in the AEC sector, which has historically been male-dominated, especially in digital and leadership positions. Women make up just 10–15% of the AEC workforce worldwide; in BIM management and coordination positions, even lower percentages around 8% [6; 36] (Fig. 1). Common wage disparities include women in BIM making up to 27% less than men in equivalent positions [6; 21]. Barriers include unequal access to upskilling, restricted mentoring, and cultural stereotypes supporting gender roles in technical occupations.

In post-socialist settings like Russia and Serbia, this disparity is especially noticeable. Kalabikhina [12] have revealed that in STEM education and jobs Russia suffers from systematic vertical and horizontal gender segregation, hence limiting women's access to BIM professions. Khasbulatova [19] criticizes the ongoing presence in Russian school

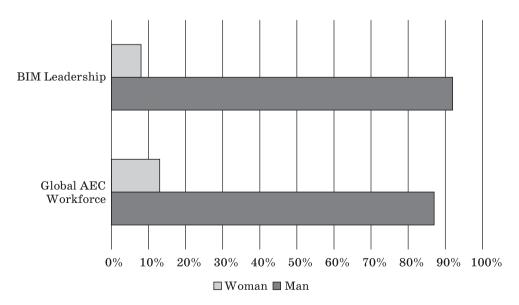


Fig. 1. The Gender Gap in AEC and BIM

of "biodeterministic" stories that discourage girls from following technical disciplines. Professional life reflects these societal and educational trends; women there suffer a double disadvantage. Pukshansky and Kanbekova [31] further reveal how managerial roles in Russia are still framed around masculine ideals, limiting women's visibility in leadership pipelines.

Babović [3] and Jovanović & Lazić [9] among others in Serbia depict the underrepresentation of women in leadership in economic and scientific fields. Though the nation develops, conventional gender roles and inadequate institutional systems impede advancement. Marković [32] underlines in the interim that many Serbian female professionals still lack institutional support, mentoring, and long-term career movement even with an increase in women-led enterprises. Serbia, on the other hand, shows considerable grassroots dynamism as well, especially with micro financing in digital entrepreneurship, which has allowed certain women to avoid official obstacles [17; 32].

Digital change, especially BIM, offers hope for democratizing access to AEC positions. BIM can highlight talents in coordination and data management above manual labor, offer up remote collaboration possibilities, and lower the physical demands often connected with building activity. Still, without deliberate policy and organizational changes, digitalization runs the danger of reproducing current inequities in a new form [29; 37].

Still, digital technology by itself does not equalize access. Aigbe et al. [1] underlined that while technology like BIM, IoT, and artificial intelligence can eliminate physical employment limits, without inclusive policies these tools run the danger of repeating legacy exclusion. There are warnings that without embedding diversity initiatives in particular corporate settings, they will be ineffective.

This paper intends to critically investigate the junction of gender and digital change in BIM-related occupations in Russia and Serbia. It contrasts institutional systems, cultural narratives, policy frameworks, and entrepreneurial prospects by means of a literature study. The study questions whether BIM can be a vehicle for gender inclusion — or whether it will support the status quo by building on theories of structural inequality, intersectionality, and innovation.

Materials and Methods

Theoretical Framework

This study draws from three interrelated theoretical frameworks: structural inequality theory, gender role / intersectionality theory, and digital innovation theory. Stamarski & Son Hing [37] define structural inequality theory as a tool to look at how institutional processes and leadership paths in AEC perpetuate gendered exclusion. Gender role theory and intersectionality, represented in the works of Kalabikhina [12], Babović [3], and Cidlinska [4], emphasize the overlapping and compounding aspects of gendered, cultural, and socioeconomic identities in career development — particularly in STEM and digital professions. Particularly via Khalin & Chernova [18] and Opoku et al. [28], the digital divide concept draws attention to inequalities in access to digital tools, training, and jobs, which are aggravated by policy stagnation or cultural prejudice.

By combining these ideas, this study not only highlights the systemic constraints faced by women in BIM but also interrogates whether the advent of Construction 4.0 technology enables genuine inclusion or reproduces pre-existing inequalities in a more sophisticated manner.

Research Design

Grounded on a comparative literature-based design, this is a qualitative, exploratory investigation. The main goal is to combine current understanding of gender and BIM in

the particular national settings of Russia and Serbia. These two post-socialist countries were chosen for their common political pasts but different paths in digital transformation and gender policy implementation. Moiseev et al. [24] underlined that Serbia and Russia vary in labor decentralization and market openness, which helps to compare institutional and cultural research.

Literature Review and Data Sources

Reviewing policy and academic papers helped to create a thorough synthesis. Among these are:

- Empirical research showing digital inequality, career obstructions, and pay disparities;
- Qualitative studies on organizational culture, leadership, and intersectional issues;
- Reports and statistical studies country by country, including Russian labor market assessments and Serbian entrepreneurial studies;
- Resources for international benchmarking include Lean In & McKinsey, APEC pay statistics.
- Case-based studies from various post-socialist and developing countries.

With at least ten sources taken from worldwide indexes like Scopus, the selection criteria gave priority to peer-reviewed journal articles and conference proceedings (from 2010 to today). Thematic content analysis was used to code articles; categories ranged from salary equity to representation to policy impact to mentorship to cultural expectations to digital access. Nikola Jovic's 2024 LinkedIn poll [10] drew original industry information, reflecting practitioner-based statistics about women's involvement in BIM.

Methodological Limitations and Rationale

Although this literature-based approach restricts the incorporation of original interview data, its strength resides in breadth and triangulation. Kalabikhina [12] and Jovanović & Lazić [9] advise that a systematic problem such gender imbalance in BIM calls for combining statistical trends, institutional criticism, and cultural interpretation. This method guarantees both depth and comparability, hence preparing the ground for organized analysis and debate in the next parts.

Results

Representation in BIM and AEC

Representation in BIM and AEC quantitative and qualitative studies validate the ongoing underrepresentation of women in BIM-related positions throughout Russia and Serbia. Women worldwide only occupy 10–15% of AEC jobs including digital coordination, BIM implementation, or data administration [6; 36]. Kalabikhina [12] claim that in Russia women are mostly directed into educational, architectural, and design documentation positions with little involvement in structural engineering, infrastructure modeling, or BIM implementation processes. Over 15 years, Navarro-Astor et al. [25] track this occupational clustering, recording the decline of female representation in decision-making positions in spite of increasing technology expectations.

Although women in tech-adjacent positions have greater entrepreneurship rates than in Russia, core AEC field involvement is still low [18]. Often limited to supporting documentation duties, women are mostly absent from BIM project leadership positions [14; 39]. Data from Jovic's LinkedIn poll [10] supports these facts; female BIM professionals said they were much less involved in clash detection, digital twin coordination, and federated model development.

Wage and Leadership Disparities

Wage disparity is still a significant structural obstacle. Women in BIM in both nations make as much as 27% less than males in comparable positions [6; 21]. Limited access to premium assignments, exclusion from strategic design, and limited involvement in Revit, Navisworks, and IFC protocol training programs help to support this difference [2; 30]. Kalabikhina et al. [14] record systematic income loss among mothers in Russia caused by state policies undercutting female labor retention, hence aggravating career advancement.

Often, leadership positions reflect the "glass cliff" whereby women are assigned transitional or unstable positions with little decision-making authority. Rodríguez-Fernández et al. [33] draw attention to how women are more likely to head teams during project crises than in stable phases, which reflects results from engineering workplaces in Serbia [5]. Moreover, badly missing are mentorship and sponsorship systems that can assist leadership changes [23; 34].

Policy and Institutional Gaps

While stressing digitization, Russia's BIM-related policies are mostly gender-neutral and ignore the inclusion gap. Kashina [16] and Khalin & Chernova [18] contend that national modernization plans lack particular policies to eliminate gendered skill gaps or apply equality in digital project procurement. Though national legislative frameworks [9; 17; 26] inconsistently support them, informal support systems and local business projects offer partial routes into BIM in Serbia.

Latukha et al. [20] show that companies with clear talent management plans targeting female inclusion tend to indicate better innovation results and team retention. Still, such behavior is more unusual than usual. Both government and business plans lack mentorship and sponsorship initiatives — generally acknowledged as accelerators for women's careers.

Cultural and Structural Barriers

Deep-seated cultural expectations still shape women as secondary players in construction and tech-related sectors. Watts [39] and Stamarski & Son Hing [37] underline how women sometimes feel compelled to embrace hyper-masculine conduct to qualify in BIM leadership positions. Media depictions in Russia support this trend; Kalabikhina et al. [13] and Norberg & Johansson [26] demonstrate how public conversation focuses women in caring or supporting roles, almost never depicting them as technologists or strategists.

Structural inflexibility in both nations makes inclusion even more difficult. Public and private sector employment in Serbia is unclear; there are few avenues for salary transparency or complaint resolution. Centralized human resource rules in Russia limit experimenting with inclusive project team compositions [18; 38]. Female professionals in both settings suffer presenteeism pressure, less maternity flexibility, and internalised prejudice that undermines their desire for promotion [23; 35].

Comparative Insights

Comparative Insights China's digital transformation plan's incorporation of gender-focused objectives provides a helpful contrast. BIM implementation in China, as Moiseev et al. [24; 30] demonstrate, is coupled with public-sector requirements for team diversity and gender-disaggregated reporting. Although still in its early stages, Nigeria's Construction 4.0 plan [1] emphasises female upskilling as a main plank, using mobile learning and community support systems to boost involvement. While uneven, Serbia's flexibility and entrepreneurial activity are encouraging; Russia's regulations are more consistent but not very inclusive.

These global comparisons show that inclusive BIM ecosystems need political will as well as structural design — neither of which are fully grown in the Russian or Serbian AEC sectors.

Discussion

Analysis of Disparities

The results support the idea that gender differences in BIM show not individual prejudices but rather systematic, ingrained processes inside the AEC industries of both Russia and Serbia. Occupational segregation — where women are mostly absent from BIM model management, digital twin deployment, or strategic planning — persists not because of lack of desire or ability but rather because of access and opportunity [9; 14; 21]. Focusing on how informal norms, historical hiring practices, and power imbalances sustain the status quo, structural inequality theory helps to clarify this. Described by Watts [39], the AEC workplace values presenteeism and long-hour visibility, which conflict with more general social expectations for women about childcare and flexibility.

The Role of BIM in Gender Inclusion

Especially by lowering physical barriers and providing dispersed team models, BIM has the ability to realign the gender balance in digital construction. These technical affordances, therefore, run the danger of repeating the same exclusion patterns in new digital forms without ingrained policy support and a change in institutional culture. Countries such as China, which clearly included diversity objectives in BIM plans [30], experienced more significant inclusion results. Pilot projects in Nigeria [1] under Construction 4.0 demonstrate that even low-resource settings can be creative with mobile learning and grassroots female recruitment. In Russia and Serbia, BIM has mostly been viewed as a technological instrument rather than a social platform for inclusion.

Institutional Accountability and Entrepreneurship

Both nations lack institutional structures linking digitization to gender equality. Russia's modernization strategy has stressed national competitiveness but not workplace equity [16; 18; 38]. Although increasingly decentralised, Serbia lacks consistency throughout its typically short-term, not structurally integrated entrepreneurial initiatives. Researchers such as Latukha et al. [20] demonstrate that companies with intentional gender-focused talent management not only foster inclusion but also gain in production, creativity, and team dynamics.

For many women left out of conventional companies, entrepreneurship — especially in Serbia — has become a workaround. Eganović [5] and Jovanović & Lazić [9] underline, nonetheless, that this route is still weighed down by legal ambiguity, insufficient mentoring, and uneven funding. Pushing women into business could also be misused to avoid required changes in formal employment systems.

The Value of Mentorship, Visibility, and Professional Identity

Mentorship, visibility, and professional identity all have value; lack of mentorship still constitutes a significant obstacle in career advancement for women in BIM. Research by Schmitt [34], Mohr [23], and Galsanjigmed & Sekiguchi [7] emphasize the need of not just formal mentorship but also role visibility and soft-skill development. Cidlinska [4] stresses that cultural validation shapes professional identity in STEM areas as much as abilities do; women need to witness others like them thrive. This is especially concerning in rural and small-business settings in Serbia, where digital BIM projects are usually underfunded and isolated [22].

Social visibility is important as well. Public narratives about women in construction are still limited and frequently stereotype reproducing, according to Jovic's 2024 Linked-In poll [10] and Kalabikhina's study on media framing [13]. Public displays of female leaders in BIM conferences, journals, or thought leadership forums are few in both nations. Younger workers lack motivation without this visibility; decision makers have no example for equity integration.

Theoretical Implications

These results confirm that multi-level intervention is needed for gender dynamics in digital transformation. Diagnosing the reproduction of prejudice inside seemingly neutral technologies still requires structural inequality theory [28]. Equally important is intersectionality; female professionals are not a monolith; background, location, parenting, and age all affect access differently [15]. Digital gap theory shows that the BIM labor market runs the risk of entrenching inequality even as it changes without inclusive onboarding and upskilling.

All things considered, BIM is a socio-technical architecture that reflects and shapes institutional logic, not just a software system. Its development will strengthen instead of controversy current power imbalances without deliberate inclusion policies.

Conclusion

This paper looked at gender differences in Building Information Modelling (BIM) and more general AEC professions in Russia and Serbia. Drawing from publications, we discovered strong proof that digitization, although hopeful in its ability to reshape labor, does not naturally eradicate gendered exclusion. Structural inequality, institutional inertia, and cultural preconceptions, rather than digitalization, still restrict women's access to leadership, important positions, and fair pay in BIM professions.

Women in both nations encounter unique yet related difficulties. Often omitting inclusion criteria from national modernization goals, Russia's centralized digital governance systems lack gender sensitivity. Though more receptive to entrepreneurial experimentation, Serbia does not often support women's businesses with regulatory certainty or long-term investment. Mentoring initiatives are lacking in both situations; leadership growth is scattered; and visibility for successful women in BIM stays low.

Notwithstanding these difficulties, our study also found possibilities. For women looking for different entrance gates into BIM, Serbia's informal digital entrepreneurial ecosystem provides a grassroots approach. Comparisons between countries, especially with China and Nigeria, show that deliberate alignment of digital policy with gender inclusion goals can produce observable outcomes. From these revelations, one might create a road map for strategic action.

Recommendations:

Set up national BIM equity indicators: Monitor participation, wage equity, and promotion statistics broken down by gender, age, and location.

Include gender-responsive procurement practices into public AEC contracts by requiring inclusive hiring and wage audits.

Design national and corporate pipelines to find and educate women for BIM-related leadership under structured mentoring and leadership initiatives.

Assist women-led BIM consulting models and startups: Offer seed capital, tax breaks, and networking opportunities.

Reform digital education and training: Guarantee access to BIM upskilling for early-career women and re-entering professionals, particularly in rural areas.

Future Research Directions:

This paper emphasizes various topics for more research. First, more longitudinal studies are required to assess how women's BIM careers change over time in reaction to policy and workplace changes. Second, among digital AEC jobs there is a lack of knowledge on the intersections of gender with other aspects such ethnicity, handicap, and socioeconomic level. Applied research on how to integrate equity into digital twin modelling environments, data structures, and BIM software design stays underexplored, finally.

Final Thought:

More than a technical breakthrough, BIM is a strategic platform that influences decision-making, work structure, and leadership selection. Ensuring female inclusion within this change is not only a question of justice but of strategic need for the AEC sector's long-term durability, creativity, and relevance. Because at the end of the day, BIM isn't just about technology. It's about people. It's about future. And the future should be for everyone.

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